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Award Number: N00014-05-1-0214

TITLE: The Efficacy of Virtual Reality in Treating Post-traumatic Stress Disorder in U.S. Warfighters Returning from Iraq and Afghanistan Combat Theaters

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Final Technical Report
January 18, 2005 - February 28, 2011

Principal Investigator: James Spira PhD
Organization: Pacific Health Research and Education Institute
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Overview

This randomized, controlled clinical trial examined the usefulness of brief cognitive behavioral therapy augmented with graded virtual reality exposure (VRE) to treat combat-related PTSD in returning OIF and OEF warfighters. A mixed within-between Group by Time experimental design was utilized. The virtual combat environment of a Middle Eastern town was developed with a clinical interface to allow the therapist to titrate visual, auditory, and kinesthetic VR stimuli with patient arousal responses. Treatment consisted of 10 sessions (2x/week) for 5 weeks, and a control group received structured minimal attention, i.e., periodic phone contact, for 5 weeks. Outcome measures included a PTSD clinical interview (CAPS), and self-report questionnaires for depression, trauma guilt, quality of life, and PTSD symptoms. They were administered to all subjects pre- and post-treatment or control periods. The VRE group received follow-up assessments at 3 and 6 months after treatment completion. Group x Time interaction for the CAPS was not significant (p=.284). However, Cluster C (avoidance and numbing) did reveal a Group x Time interaction (p=.008), and Guilt was also improved (Group x Time interaction, p=.039). No other significant results were obtained, possibly due to a small number of treatment completers. Only 10 of 29 treatment group subjects completed all 10 sessions. No adverse reactions were reported. Brief CBT with VR exposure may be useful in treating combat PTSD in selected warfighters; however, more research is needed to determine the efficacy of this novel treatment approach.

a. Scientific and Technical Objectives

Continuing exposure to potential death or serious injury places military personnel deployed to combat theaters at high risk for developing post-traumatic stress disorder (PTSD). Utilizing virtual reality (VR) technology, this project examined the effect of an innovative psychotherapeutic intervention to reduce psychological problems associated with PTSD OEF/OIF combat deployed military personnel.

The overarching objective of this project was to maximize the effectiveness of early treatment of military-related PTSD, and to provide a model for the assessment, diagnosis, and treatment of psychological trauma. While the study's ultimate goal was to contribute to the early treatment of PTSD, and to broaden the understanding of how virtual reality technology can improve care given to warfighters wounded in combat, its immediate focus was to develop viable clinical applications of VR technology for early assessment and treatment of combat-related psychological trauma and associated disorders. The study evaluated the efficacy of VR exposure therapy combined with cognitive behavioral therapy (CBT) in treating PTSD in U.S. warfighters returning from the Iraq and Afghanistan combat theaters. It was hypothesized that exposure to high resolution VR displays of relevant combat scenarios during CBT would significantly reduce PTSD symptoms compared to a minimal attention control condition.

b. Approach

This project was a randomized controlled clinical trial using a between group pre-post experimental design. The PTSD treatment approach combined virtual reality exposure (VRE) with cognitive behavior therapy. A

computer-generated virtual combat environment set in a Middle East urban environment was developed with a clinical interface that provided the treatment therapist control over the visual, auditory, and kinesthetic elements experienced by the participant. The experimental treatment consisted of 10 biweekly VRE sessions for 5 weeks. The control group received structured minimal attention (MA) for 5 weeks before beginning VRE treatment, if desired. A PTSD clinical interview, and self-report questionnaires (depression, trauma guilt, quality of life, PTSD symptoms) were the outcome measures, and were administered pre- and post-treatment and at other control periods. Biopak equipment was used during VRE treatment to obtain physiologic data, i.e., heart rate, skin conductance, and respiration. At the conclusion of each session, subjects in the treatment condition completed a brief self-report rating scale of the virtual reality experience. Follow-up assessments on the outcomes measures were conducted at 3 and 6 months after treatment completion.

The intervention consisted of Prolonged Exposure, developed by Edna Foa and associates enhanced with a VR environment. The VR included a convoy scene that took about 10 minutes to complete. The convoy scene was repeated throughout the PE protocol. Subjects were selected based on their having had an index trauma that was associated with a convoy. The VR enhanced PE protocol was delivered twice a week for five weeks, or a total of 10 sessions Each session consisted of checking in regarding homework and experiences since the prior session, engaging in the PE exposure session while watching the VR scene, periodically stating their subjective units of distress, retelling of their trauma narrative, and cognitive restructuring. Homework included exposure practice, and listening to one's trauma narrative recorded in the treatment sessions. Subjects were active duty soldiers, recruited from the US Army, either at Tripler Army Medical Center or Schofield Barracks. After baseline testing, subjects were randomized to either VR or attentional control treatment conditions. Subjects were retested post treatment, and again at 3 and 6 months.

c. <u>Concise Accomplishments</u>

Data regarding the number of subjects recruited, treated, and analyzed are presented in Table 1, below.

As can be seen, 64 subjects were enrolled, 47, completed eligibility assessments, and 42 were randomized; demographics are included.

Table 1. Summary of Participant Demographic Information (includes all screened participants)

	Enrolled (N = 64)	Completed Eligibility Assessments (N = 47)	Randomized (N = 42)
Age (years)	M = 30.09 (SD = 6.10)	M = 29.72 (SD = 5.93)	M = 30.05 (SD = 6.10)
Sex	-----	-----	
Male	N = 59 (92.2%)	N = 45 (95.7%)	N = 41 (97.6%)
Female	N = 5 (7.8%)	N = 2 (4.3%)	N = 1 (2.4%)
Ethnicity	-----	-----	-----
African American	N = 7 (10.9%)	N = 5 (10.6%)	N = 3 (7.1%)
Asian American	N = 1 (1.6%)	N = 0 (0%)	N = 0 (0%)
Caucasian	N = 36 (56.3%)	N = 25 (53.2%)	N = 23 (54.8%)
Hispanic/Latino	N = 11 (17.2%)	N = 9 (19.1%)	N = 8 (19.0%)
Pacific Islander	N = 5 (7.8%)	N = 5 (10.6%)	N = 5 (11.9%)
Other	N = 4 (6.3%)	N = 3 (6.4%)	N = 3 (7.1%)
Education	-----	-----	-----
Some High School	N = 1 (1.6%)	N = 1 (2.1%)	N = 0 (0%)
High School Diploma/GED	N = 20 (31.3%)	N = 13 (27.7%)	N = 11 (26.2%)
Some College	N = 35 (54.7%)	N = 27 (57.4%)	N = 25 (59.5%)
Bachelor's Degree	N = 6 (9.4%)	N = 4 (8.5%)	N = 4 (9.5%)
Graduate/Professional Degree	N = 2 (3.1%)	N = 2 (4.3%)	N = 2 (4.8%)
Marital Status	-----	-----	-----
Never Married	N = 8 (12.5%)	N = 6 (12.8%)	N = 6 (14.3%)
Married	N = 48 (75.0%)	N = 35 (74.5%)	N = 30 (71.4%)
Separated	N = 4 (6.3%)	N = 3 (6.4%)	N = 3 (7.1%)
Divorced	N = 4 (6.3%)	N = 3 (6.4%)	N = 3 (7.1%)
Living with Partner	-----	-----	-----
Yes	N = 43 (67.2%)	N = 30 (63.8%)	N = 26 (61.9%)
No	N = 21 (32.8%)	N = 17 (36.2%)	N = 16 (38.1%)
Rank	-----	-----	-----
E-1 to E-3	N = 2 (3.2%)	N = 2 (4.2%)	N = 1 (2.4%)
E-4	N = 29 (46.0%)	N = 24 (51.1%)	N = 23 (54.8%)
E-5	N = 17 (27.0%)	N = 11 (23.4%)	N = 10 (23.8%)
E-6 to E-7	N = 7 (11.1%)	N = 5 (10.6%)	N = 3 (7.2%)
E-8 to O-4	N = 8 (12.7%)[a]	N = 5 (10.6%)	N = 5 (11.9%)
Number of Deployments	-----	-----	-----
Iraq	M = 1.56 (SD = 0.84)	M = 1.61 (SD = 0.75)	M = 1.61 (SD = 0.74)
Afghanistan	M = 0.30 (SD = 0.53)	M = 0.16 (SD = 0.42)	M = 0.18 (SD = 0.45)
Other	M = 0.61 (SD = 2.23)	M = 0.33 (SD = 1.09)	M = 0.32 (SD = 1.14)
Total Months Deployed	-----	-----	-----
Iraq	M = 17.07 (SD = 10.16)	M = 17.60 (SD = 8.85)	M = 17.43 (SD = 8.55)
Afghanistan	M = 3.40 (SD = 6.43)	M = 1.88 (SD = 5.23)	M = 2.11 (SD = 5.51)
Other	M = 1.84 (SD = 4.48)	M = 1.48 (SD = 3.55)	M = 1.18 (SD = 3.21)

[a]Missing (N = 1)

The eligibility flow chart is provided in Figure 1 below. Figure 2 shows the flow of subject attrition throughout each stage of the study. 12 subjects completed minimal attentional control condition and immediate post treatment assessment, whereas 10 completed the VR treatment condition and immediate post treatment assessment. Despite efforts to contact subjects for later follow-ups, there were insufficient subjects remaining for analysis. Reasons for study drop out are explained at each stage.

Figure 1
Virtual Reality PTSD Study
Flow Chart: Eligibility Process

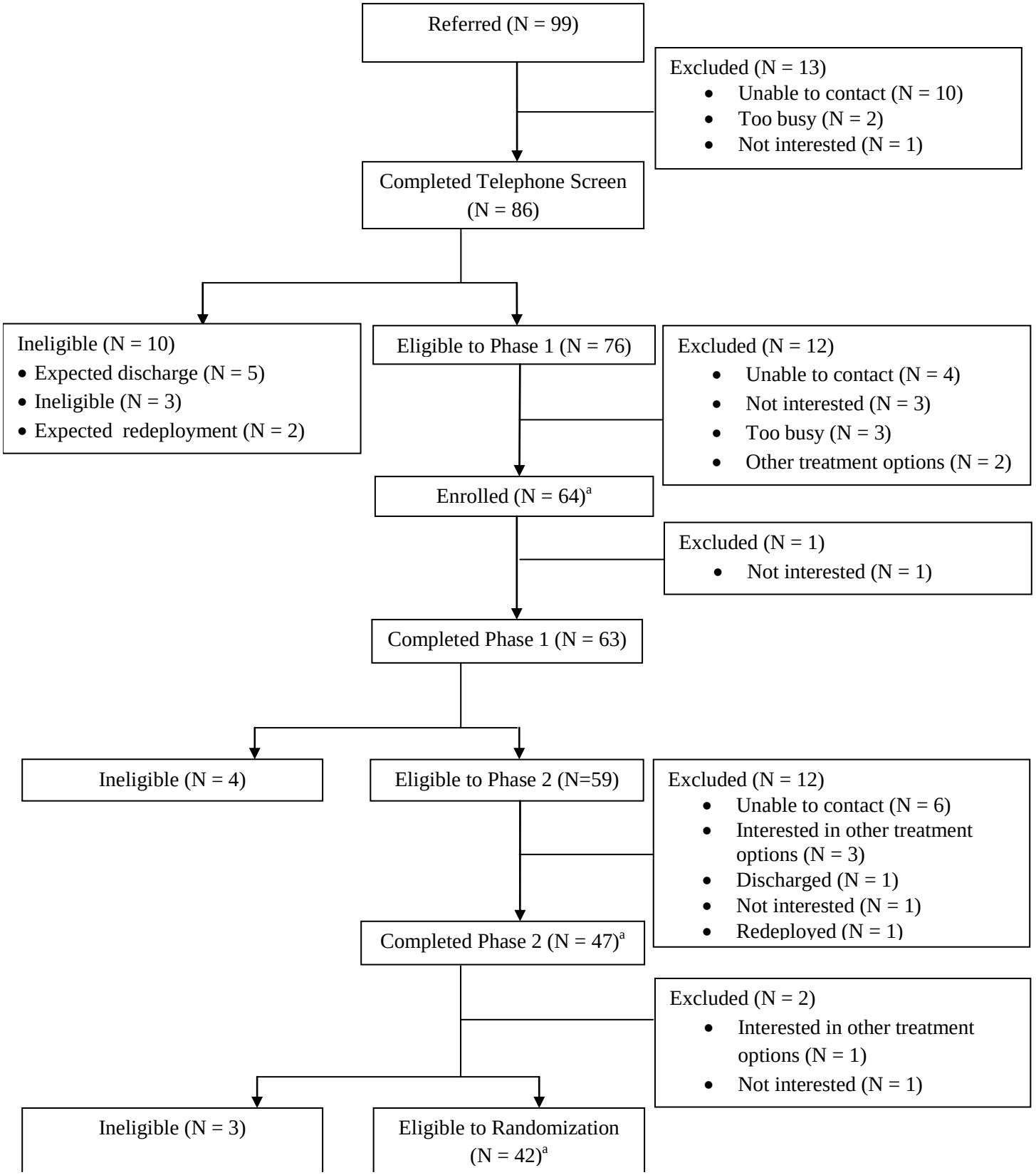
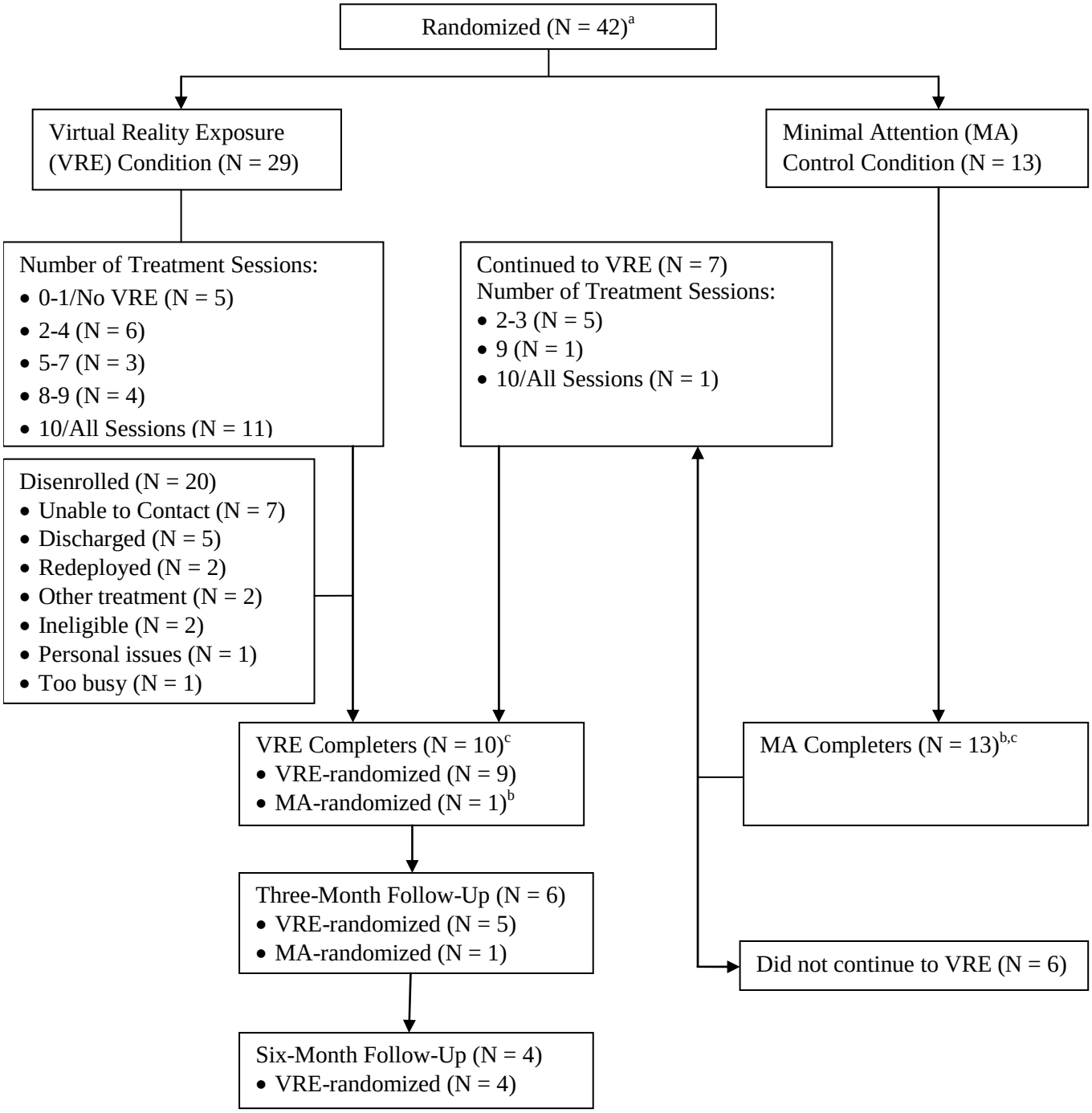


Figure 2
Virtual Reality PTSD Study
Flow Chart: Randomized Participants



[a]See Table 1 for Demographic Information of Enrolled, Completed Eligibility, and Randomized Participants.
[b]One MA-Completer also completed VRE treatment. This participant was included in VRE-Completer analyses; thus, the final MA-Completer sample size is 12.
[c]See Table 2 for Demographic Information of VRE Treatment and MA Control Condition Completers.

Table 2 shows the demographics of the completed subjects upon which Analysis was conducted.

Table 2. Summary of Demographic Information (22 completed participants)

	Treatment (n = 10) Mean (SD)[a]	**Control (n = 12) Mean (SD)[a]**
Age (years)	33.60 (7.76)	27.42 (5.53)
Sex (% Male)	100%	100%
Ethnicity	-----	-----
African American	N = 2 (20%)	N = 0 (0%)
Caucasian	N = 5 (50%)	N = 7 (58.3%)
Hispanic	N = 1 (10%)	N = 3 (25%)
Pacific Islander	N = 2 (20%)	N = 1 (8.3%)
Other	N = 0 (0%)	N = 1 (8.3%)
Education	-----	-----
High School Diploma/GED	N = 3 (30%)	N = 4 (33.3%)
Some College	N = 6 (60%)	N = 7 (58.3%)
Bachelor's Degree	N = 0 (0%)	N = 1 (8.3%)
Graduate/Professional Degree	N = 1 (10%)	N = 0 (0%)
Marital Status	90% Married	75% Married
Living with Partner	80% Yes	58.3% Yes
Rank	-----	-----
E-4	N = 5 (50%)	N = 7 (58.3%)
E-5	N = 0 (0%)	N = 4 (33.3%)
E-6	N = 1 (10%)	N = 1 (8.3%)
E-8	N = 4 (40%)	N = 0 (0%)
Months Deployed	-----	-----
Iraq	18.35 (10.29)	19.83 (8.39)
Afghanistan	0.0 (0.0)	3.08 (7.72)
Combat Exposure Scale (max = 41)	25.0 (8.68)	24.75 (8.10)

Table 3 shows pretreatment data for those randomized to treatment and control groups

Table 3. Summary of Pre-treatment Outcome Data

	Treatment (n = 10) Mean (SD)[a]	Control (n = 12) Mean (SD)[a]
CAPS	72.2 (17.07)	75.0 (19.29)
Posttraumatic Diagnostic Scale	-----	-----
Impairment[b]	2.20 (0.79)	2.42 (0.79)
Number of Symptoms (max = 17)	14.80 (1.93)	15.33 (1.83)
Symptom Severity Score (max = 51)	33.4 (9.88)	30.75 (10.38)
Symptom Severity Rating[c]	3.30 (0.82)	3.17 (0.84)
Beck Depression Inventory-II (max = 63)	25.5 (13.34)	24.58 (11.74)
Quality of Life Inventory	-----	-----
Raw Score	0.92 (2.42)	-.24 (2.23)
Percentile	29.60 (33.67)	17.42 (31.06)
T Score	37.20 (19.10)	28.25 (17.39)
Overall[d]	2.10 (1.20)	1.83 (1.27)
Trauma-Related Guilt Inventory (max = 128)	51.40 (23.04)	52.25 (20.58)

Note. CAPS = Clinician-Administered PTSD Scale for DSM-IV.
[a]Unless otherwise indicated.
[b]0 = No Impairment; 1 = Mild; 2 = Moderate; 3 = Severe
[c]1 = Mild; 2 = Moderate; 3 = Moderate to Severe; 4 = Severe
[d]1= Very Low; 2 = Low; 3 = Average; 4 = High.

Table 4 shows thee results of analysis on the 22 completed subjects

Table 4. Summary of Post-treatment Outcome Data

	Treatment (n = 10) Mean (SD)[a]	Control (n = 12) Mean (SD)[a]
CAPS (max = 136)	58.9 (23.29)	71.17 (25.41)
Posttraumatic Diagnostic Scale	-----	-----
Impairment[b]	2.30 (1.06)	2.50 (0.91)
Number of Symptoms (max = 17)	13.10 (3.78)	13.58 (3.9)
Symptom Severity Score (max = 51)	27.3 (13.29)	25.25 (12.02)
Symptom Severity Rating[c]	2.70 (0.95)	2.67 (0.99)
Beck Depression Inventory-II (max = 63)	23.7 (11.72)	22.67 (10.83)
Quality of Life Inventory	-----	-----
Raw Score	0.43 (2.48)	0.33 (2.70)
Percentile	26.60 (31.74)	25.92 (36.06)
T Score	33.30 (19.42)	31.17 (22.82)
Overall[d]	1.8 (1.03)	2.08 (1.31)
Trauma-Related Guilt Inventory (max = 128)	37.3 (21.21)	52.25 (23.54)

Note. CAPS = Clinician-Administered PTSD Scale for DSM-IV.
[a]Unless otherwise indicated.
[b]0 = No Impairment; 1 = Mild; 2 = Moderate; 3 = Severe
[c]1 = Mild; 2 = Moderate; 3 = Moderate to Severe; 4 = Severe
[d]1= Very Low; 2 = Low; 3 = Average; 4 = High.

Table 5 Shows Results for CAPS&TRGI

Table 5. Results for CAPS & TRGI (Significant Findings in Bold)

CAPS

2 (Condition-VR, Control) x 2 (Time-Pre, Post-Condition) Repeated-Measures ANOVA:

Main Effect: $F(1,20) = 3.867$, $p = 0.063$

Interaction Effect: $F(1,20) = 1.214$, $p = 0.284$

CAPS – Cluster B

2 (Condition) x 2 (Time) Repeated-Measures ANOVA:

Main Effect: $F(1,20) = 0.433$, $p = 0.518$

Interaction Effect: $F(1,20) = 0.057$, $p = 0.814$

CAPS – Cluster C

2 (Condition) x 2 (Time) Repeated-Measures ANOVA:

Main Effect: $F(1,20) = 6.029$, $p = 0.023$

Interaction Effect: $F(1,20) = 8.705$, $p = 0.008$

Mann-Whitney U Test – Change Scores by Condition:

$U = 18.00$, $Z = -2.787$, $p = 0.004$

CAPS – Cluster D

2 (Condition) x 2 (Time) Repeated-Measures ANOVA:

Main Effect: $F(1,20) = 4.088$, $p = 0.057$

Non-significant Interaction Effect: $F(1,20) = 0.167$, $p = 0.687$

TRGI

2 (Condition) x 2 (Time) Repeated Measures ANOVA:

Main & Interaction Effects: $F(1,20) = 4.858$, $p = 0.039$

Mann-Whitney U Test – Change Scores by Condition:

$U = 32.00$, $Z = -1.849$, $p = 0.069$

Wilcoxon Signed Ranks Test - Pre-Post for VR Completers:

$Z = -2.095$, $p = 0.036$

Interpretation of Results:

Main Hypothesis: A 2 (Condition-VR, Control) x 2 (Time-Pre, Post-Condition) Repeated-Measures ANOVA. Main Effect: $F(1,20) = 3.867$, $p = 0.063$ and Interaction Effect: $F(1,20) = 1.214$, $p = 0.284$ show a lack of effect for the CAPS.

CAPS – Cluster B: A 2 (Condition) x 2 (Time) Repeated-Measures ANOVA showed a lack of effect for Re-experiencing; Main Effect: $F(1,20) = 0.433$, $p = 0.518$, Interaction Effect: $F(1,20) = 0.057$, $p = 0.814$

CAPS – Cluster C: A 2 (Condition) x 2 (Time) Repeated-Measures ANOVA showed an effect for Avoidance reduction for treatment over control; Main Effect: $F(1,20) = 6.029$, $p = 0.023$; Interaction Effect: $F(1,20) = 8.705$, $p = 0.008$. A non-parametric test due to small sample size resulting in non-normal distribution. Mann-Whitney U Test – Change Scores by Condition yielded significance as well. $U = 18.00$, $Z = -2.787$, $p = 0.004$

CAPS – Cluster D. A 2 (Condition) x 2 (Time) Repeated-Measures ANOVA failed to show a significant decreases in Hyperarousal for Treatment over Controls; Main Effect: $F(1,20) = 4.088$, $p = 0.057$; Non-significant Interaction Effect: $F(1,20) = 0.167$, $p = 0.687$

TRGI: A 2 (Condition) x 2 (Time) Repeated Measures ANOVA showed a reduction for treatment vs control for Guilt; Main & Interaction Effects: $F(1,20) = 4.858$, $p = 0.039$. Due to small sample leading to a non-normal distribution, a non parametric test was utilized, showing marginal significance; Mann-Whitney U Test – Change Scores by Condition: $U = 32.00$, $Z = -1.849$, $p = 0.069$; and Wilcoxon Signed Ranks Test - Pre-Post for VR Completers, $Z = -2.095$, $p = 0.036$

d. Expanded Accomplishments

See attached presentations.

e. Work Plans

NA – Final Report

f. Major Problems/Issues

Recruitment and retention were the major problems with completion of this protocol. Although participant recruitment improved substantially as a result of increased outreach activities, participant availability for treatment sessions and post-assessments was generally inconsistent. Work demands, lengthy training assignments, other medical appointments, medical discharges, re-deployments, and new family responsibilities often resulted in missed appointments, rescheduling, and/or premature study termination. Timely follow-up of appointment no-shows by the project staff, and increased flexibility in scheduling aided retention. To facilitate participants' completion of the treatment and assessments, recent protocol modifications were made to reduce the burden on participants' time by eliminating or reducing the duration of several study phases.

As the clinic increased in staff, the project also encountered an issue with the availability of assessment and treatment space at the clinic. Staff offices replaced the rooms used for assessments, which created a temporary scheduling problem as only the treatment room was available for all study appointments. The clinic director was helpful in acquiring new project space, and the VR system were-located in mid-summer 2009 to newly renovated rooms at another nearby clinic. Plans were made to minimize the disruption to scheduled appointments.

Follow ups were changed from 12 months to 6 months, and 6 months to 3 months in order to reduce drop outs and achieve more data points and minimize the effects of missing data. In addition, the 8-week medication lead-in requirement was discontinued as changes in medications and dosing regimens were frequent and precluded many participants from initiating active study participation. It was anticipated that these changes would facilitate participation, session attendance and study completion. More scheduling flexibility for the pre-, post-, and follow-up assessments was achieved when a replacement assessment clinician was hired and trained early in the performance period.

g. Technology Transfer

The study design, methodology, treatment protocol, and VR software have been used to develop and implement VR treatment research protocols at Brooke Army Medical Center and the Institute of Surgical

Research in San Antonio, Texas to treat severely burned warfighters with combat-related PTSD. The VR software was made available to a research investigator at a New York trauma treatment center to use with patients suffering from combat-related PTSD. The VR software was also demonstrated to medical and mental health providers at Schofield Barracks and Tripler Army Medical Center in Hawaii. Interest in the VR environment has been expressed by providers at the VA Pacific Islands Health Care System in Hawaii where the study protocol will soon be implemented. Demonstrations will be conducted when the VR system is installed and operational at the VA study site.

The VR environment and VR exposure treatment protocol for PTSD are currently available to other investigators with appropriate training in the proper use of the materials for research purposes. After the study has been completed and the outcomes analyzed the VR software and a modified treatment protocol will be available for clinical use at the local military and VA medical centers. These materials may be distributed to other DOD and VA medical facilities with appropriate training on their use in exploring whether adding VR to traditional exposure therapy for combat related PTSD is of value.

Future research should consider the possibility that having a single, brief virtual environment is insufficient to benefit patients compared to a greater range of virtual environments and of longer duration and richer in nature. Multiple therapists should also be employed to factor out specific reactions to a single therapist that patients may have. Further, every effort should be made to reduce drop outs in any future research of this method.

h. Foreign Collaborations and Supported Foreign Nationals

None.

Treating Combat PTSD with Virtual Reality Exposure Therapy

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Abstract. Posttraumatic Stress Disorder (PTSD) is one of the most debilitating disorders experienced by soldiers returning from combat. Few empirically validated PTSD treatments are currently available, particularly for combat-related trauma. Virtual reality exposure (VRE) treatment shows promise in treating combat-related PTSD. This ongoing study is a randomized clinical trial to assess the efficacy of a novel VRE intervention for treating warfighters with PTSD. Outcome variables include PTSD severity, psychological and physiologic factors.

Keywords. Virtual reality, PTSD, cognitive behavior therapy, exposure therapy

1. Introduction

Posttraumatic stress disorder (PTSD) is one of the signature injuries of the current conflict in Iraq and Afghanistan. Roadside and car bombs as well as hand-thrown and rocket-propelled grenades are major sources of death, traumatic injuries, and PTSD. A recent review found that 14% of U.S. troops returning from Iraq screened positive for PTSD.[1] Unless their PTSD is effectively treated, many of these warfighters and veterans may suffer significant long-term psychological, occupational, social, and physical health problems that will place a considerable burden on society for healthcare and disability support.

Cognitive-behavioral therapy (CBT) employing an exposure treatment protocol is one of the primary non-pharmacologic treatments recommended by practice guidelines for PTSD. Empirical evidence suggests that exposure therapy is efficacious in reducing PTSD symptoms.[2] Immersive virtual reality (VR) may offer a potent augmentation to CBT for treating both civilian and combat-related PTSD.[3,4] VR exposure treatment (VRE) helps individuals to gain access to traumatic memories that they often try to avoid. Overcoming their avoidance to the unpleasant memories enables them to more successfully deal with their trauma. This study examines the efficacy of using VR exposure therapy for treating PTSD in U.S. warfighters returning from combat theaters in Iraq and Afghanistan.

2. Methods

This is a randomized controlled clinical trial with two conditions, VR exposure treatment (VRE) and minimal attention (control). VRE treatment consists of a 10- session CBT intervention augmented with a VR environment. Treatment involves graded presentation of visual, auditory, and kinesthetic stimuli to stimulate memory recall of traumatic combat events in a safe, therapeutic setting. While wearing a 3D VR helmet participants experience a generic Middle Eastern urban setting as they ride in a virtual Humvee on patrol. A therapist helps participants to access and process their memories of the traumatic event, ideally leading to long-term reductions in PTSD symptoms. Outcome measures include PTSD severity and symptoms, depression, quality of life, guilt, and presence. Heart rate, blood pressure, skin conductance, temperature, and respiration are also measured during each session. Between group data analysis will be conducted with treatment completers, and an intent-to-treat analysis will be performed on non-completer data.

3. Results

Participant recruitment and enrollment are currently in progress, and data collection is continuing. Although no formal analysis of the data has yet been conducted, a preliminary review of a few completed cases as well as anecdotal feedback from study participants provide insight to potential outcomes.

4. Conclusions

Although challenging, randomized clinical trials such as the current study are needed to determine the efficacy and viability of VRE to treat combat-related PTSD. The study VR treatment protocol and environment were specifically designed for treating combat PTSD, which is a national U.S. Defense health priority. Brief case summaries will be discussed and relevant issues explored during the presentation. In addition, lessons learned about the implementation of the study protocol, development of a clinical VR application, PTSD treatment of active duty populations, and other relevant project components will be shared. The outcomes of the study may contribute substantially to improving the treatment of PTSD for warfighters and civilian populations.

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Virtual Reality Therapy for Combat-Related Post-traumatic Stress Disorder

Sarah D. Miyahira, PhD, Raymond A. Folen, PhD,
Michelle Kawasaki, MA, James Spira, PhD, MPH

Abstract

A randomized controlled clinical trial was conducted to examine the effect of brief graded virtual reality exposure (VRE) therapy to treat combat-related PTSD in Iraq and Afghanistan warfighters. VRE treatment consisting of 10 sessions (twice a week for five weeks) was compared to a control group receiving minimal attention (MA) for five weeks. Although no improvement for overall PTSD scores were found in the VRE compared to the MA group, significant reductions were achieved in numbing/avoidance and guilt components of PTSD. Large attrition rates, small sample size, and a single VR environment limited the generalizability of the findings.